PCT/AU2004/000948

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SPORTS TRAINING AND TESTING METHODS, APPARATUS AND SYSTEM

This invention relates to sports training and testing methods, apparatus and system.

This invention has particular but not exclusive application to a sports training and testing methods, apparatus and system applicable to a wide range of sports including all football codes, athletics, snow and ice sports, tennis, hockey and any other sport where strength, fitness and/or agility are important. For illustrative purposes reference will be made to such application. However, it is to be understood that this invention could be used in other applications, such as the training and testing of animals.

The preparation of athletes (human, equine or otherwise) involves a varying combination of optimising performance in a number of areas, such as follows:

1.) Locomotive abilities including speed, acceleration, agility (the ability to change direction), endurance, speed endurance, power, balance and coordination

2.) Decision making ability – the ability to make strategic decisions based on internal and external stimuli and occurrences

3.) Motor processing – including aspects such as reaction time – the combination of collecting and processing internal or external information, formulation a decision, and effecting this decision by changing or maintaining the current activity

4.) Tactical ability and strategy – formulating the best combination of behaviours or movement in order to achieve a desired result. This

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aspect can be either pre-meditated or formulated in response to internal/external stimuli.

5.) Ability to perform to capacity – including freedom from injury or fatigue which may negatively affect performance

Maximising capability in these areas requires learning, practice and adjustment, until such a time that the desired performance is reached. There are a wide variety of interventions in the sporting world aimed at improving these factors, most of which work on the cyclical system of providing a stimulus or command, which in turn calls for a performance of movement, which has a result or outcome, which provides a feedback mechanism or result to the athlete.

Much of the prior art application of technology to sport focuses on providing retrospective feedback to the athlete or coach. That is, the majority of such devices are used as testing tools, rather than actually providing a training stimulus. The sport and exercise environments are becoming increasingly populated with electronic devices for measuring physical performance and biological responses to various types of physical performance tasks. While these devices are able to provide feedback information on various aspects of physical, tactical, and skill based performances, they do not provide direct stimuli for improving training efficacy. As such these disparate devices do not stimulate the cognitive or tactical aspects of athletic performance such as decision-making, reaction time, peripheral vision or environmental awareness that are crucial in the sporting context.

At present many aspects of sports training and testing are performed manually with considerable subjective elements and potential for bias due to human error. Of the automated fitness test protocols that exist, most of these must

be performed in a controlled laboratory environment due to the expense, size and complexity of the equipment involved.

It would be advantageous to have a system that performs the full process of providing a training stimulus, measuring the outcome/performance, and reporting the outcome to the athlete or trainer in real time.

This invention in one aspect resides in a sports training and testing method including the steps of:

initiating a predetermined protocol within a control unit;

instructing a plurality of remote terminals to produce a series of stimuli in response to the protocol;

receiving feedback information from at least one sensor in response to the stimuli, and

transmitting the information to said control unit.

In another aspect, this invention resides in a sports training and testing apparatus including:

a control unit adapted to implement a predetermined protocol;

a plurality of remote units for providing a series of stimuli in response to the protocol, and

at least one sensor for providing feedback information in response to the stimuli to said control unit.

In a further aspect, this invention resides in a sports training and testing system including:

an on field network including:

- a control unit adapted to implement a predetermined protocol;

- a plurality of remote units for providing a series of stimuli in response to the protocol, and
- at least one sensor for providing feedback information in response to the stimuli to said control unit, and

a communications link coupling the on field network to an off field network, the off field network including:

- a terminal for receiving from said control unit via the communication link the feedback data for post processing, and
- a memory for storing the post processed data

In a still further aspect, this invention resides in a sports training and testing method including the steps of:

initiating a predetermined protocol within a control unit;

instructing a plurality of remote terminals to produce a series of stimuli in response to the protocol;

receiving feedback information from at least one sensor in response to the stimuli; and

transmitting the information across a communications link a remote terminal;

processing the received information within the terminal; and

storing the processed information.

The protocol may include one or more pre-programmed or user defined stimuli activation patterns for a series of physical activities.

Preferably, the control unit is a computer, a portable computer, a personal digital assistant (PDA), palm top, mobile phone or other such suitably portable processing device.

The stimuli may be audio, visual or a combination thereof. Preferably the stimuli are mounted on the remote unit but may also be mounted separately to the remote unit. Optionally the remote units may include a data capture unit having a memory. The remote unit may then receive feedback information from the sensors before forwarding the information to the control unit. In this example, the remote unit may acts as an intermediate hop.

Preferably, the sensors are biometric sensors but the system may also utilise other sensor devices such as timing, pressure, pedometers, accelerometer or the like.

The communication link may be a wireless link such as a Radio Frequency (RF), GSM, CDMA, GPRS, Microwave, laser, Infra Red (IR) , 802.11(Wireless Ethernet), Bluetooth or other such suitable wireless communication schemes. Alternatively, the communications link may be a wired connection such as LAN, WAN, Internet, Plain Switch Telephone Network (PSTN), Plain Old Telephone System (POTS), Integrated Services Digital Network (ISDN) or the like.

Preferably, the remote terminal is a workstation running suitable software for processing the feedback data. The workstation may optionally include an internet connection. Furthermore, the workstation may also include a protocol development suite allowing a trainer to tailor a protocol to an athlete's specific training needs.

The processed information is preferable stored in a data base allowing a trainer access to historical information about an athlete's progress and adapt the training regime accordingly. Optionally the trainer may receive intermediate report regarding the athlete's performance during the training secession, allowing the trainer to modify the regime in real time if necessary.

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In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention and wherein:

FIG. 1 is a schematic representation of the system of the invention as described;

FIG. 2 illustrates components of the on field network of the invention;

FIG. 3 illustrates an example of a reactive sprint/agility protocol;

FIG. 4 illustrates an example of a five-point reactive agility protocol;

FIG. 5 illustrates an example of a reactive offensive/defensive protocol;

FIG. 6 illustrates an example of a four player reactive tactical protocol;

FIG. 7 illustrates an example of a pacing 400m sprint protocol;

FIG. 8 illustrates an example of a cycling individual pursuit race protocol, and

FIG. 9 illustrates an example of a multi-zone timing/pacing protocol;

A diagrammatic representation of a preferred embodiment of a sports training and testing system in accordance with the invention is shown in FIG. 1. The preferred training and testing system of the invention has two major components, being and on field network and an off field network. The two networks are coupled by communication link that enables transfer of data and information therebetween.

As shown in FIG. 2, the on field network includes at least two main components, being remote data units and a control unit. Various add-in components may be also utilised to enhance the capabilities of the on field network.

The remote data units can be placed in a wide variety of configurations limited only by the range of the radio frequency system used. In one embodiment of the system of the invention, this range is at least 200 metres line-of sight. Furthermore, each remote data unit can function as a relay/routing device, thus greatly extending the overall range of the system. Theoretically such a system would be unlimited temporally, provided a distance of no larger than the available transmission range separated any two of the remote data units. Each unit is powered with a removable rechargeable battery unit, and can be replaced with commercial non-rechargeable cells in that event of the rechargeable cells failing. Alternatively, the units could be powered using solar panel, or another form of radiant energy such as microwave.

The remote data unit includes at least two components, being a data capture unit and a reactive unit. In a preferred embodiment, the data capture unit and reactive unit are combined in a singular housing and mounted on an adjustable tripod, stand, floor or fence. The remote data unit can also be mobile or portable. For example, the remote data unit may be worn by the athlete or attached to another object such as a bicycle or automobile. Of course, it is to be appreciated that a person skilled in the art would recognise that the receptive and reactive units may be separated for logistical reasons.

While the described embodiment of the training and testing system of the invention utilises wireless communication by one of the public radio frequency bands as the chosen transmission medium, this could be replaced by a hardwired system of data relaying, or an alternative wireless protocol such as microwave, infrared, GPRS or the like. All remote data units can communicate with each other via a wireless or wired medium suitably using fault tolerant technology and are

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equipped with at least one programmable computing device such as a micro-controller.

Each data capture unit of the remote data unit is responsible for collecting information and relaying it to the control unit. In one embodiment, the data units capture timing information using photobeam switches (known in the industry as "timing lights"). Through either reflection or transmission of light the state of the switch depends on whether the light beams are broken or not. When the beam(s) are broken by the passage of an athlete, a simple event signal is sent back to the control unit.

In further embodiments, the data capture unit may be used to collect biosensor information such as heart rate or blood pressure, collect position information from GPS or other tracking units, or other types of sport sensor (such as an accelerometer or ergometer).

The unit generally consists of a microcontroller or microprocessor with a program stored in memory. Each individual receptor unit has a unique identification label (ID). The ID is stored in receptor unit in a manner by which is accessible to the stored program. For example, the ID can be stored in the Read Only Memory (ROM) of a microcontroller.

In the case of the wireless embodiment of the system of the invention, the signal sent back to the control unit is more than a simple event signal; it will also include the unique ID of the remote unit. The message sent back to the control unit may also consist of a timestamp indicating the exact moment when the beam-breaking event occurred. Alternatively the event may be time stamped at the control unit when the message is received.

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There are several other means by which the real-time measurement of movement speed could be replicated, such as:

1.) The use of GPS tracking or another system of signal triangulation such as sonar (Doppler tracking) or microwave tracking;

2.) The use of an ID tag system for measuring the proximity of an athlete to specific transmitters.

3.) The use of accelerometers for measurement of movement speed and direction changes.

Turning to the reactive unit, it may interpret communication from the control unit or from the remote data units in order to perform a specific function. This can range from producing a stimulus for the athlete(s), to operating a wake/sleep mode for power saving. The reactive data units also contain an array of external light emitting diodes (LEDs) for providing visual information to the athlete, and a speaker for providing auditory signals. The array of LEDs may be of any number and colour configuration, and may also be configured to produce alphanumeric signals or symbols to add information to the visual stimuli. For example, the LED panel may flash the figure "1.23" in the colour red, to indicate that the athlete is 1.23 seconds behind the desired pace for the event. Other embodiments may include other light sources (such as Xenon strobe lights), a video display, or a holographic projection from the unit.

Concurrently with providing visual information or in the alternatively, the unit may produce an auditory command saying, "speed up", and display the timing deficit on the visual display panel. A speaker may be used to emit signals of various tones and pulse frequency, though once may include options for voice, music or other auditory signals. For example, a high-pitched tone could be issued

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to signal the athlete to turn left, however this could be replaced by a voice signal saying, "left".

The control unit is a computerised device that coordinates the remote data units, as well as providing various other functions. The control unit may be a pocket mobile computer, a PDA, a laptop, a desktop computer, a pocket compatible mobile phone or the like. In a further embodiment, the control unit includes typical computer components, such as a processing unit, display screen, memory, storage, input and output devices, communication ports, global network connectivity, etc. Suitably, the control unit is capable of coordinating a wide range of wireless data signals and commands without losses due to interference.

Some desired features of the control unit are as follows:

- The control unit receives signals from the data capture unit and sends commands to the reactive units. In one embodiment, this transmission occurs via radio frequency, however other transmission mediums could be used, such as cables, infra-red, microwave, ultra-wideband, Bluetooth, 802.11, or the like.
- The interaction between the control, data capture and reactive units is essentially coordinated in a field bus approach, utilising the intelligence of microcontroller technology and in-system programming.
- The control unit contains a series of transceivers for grouping remote data units into "lanes" for ease of data management, with a different radio frequency for each lane. Division of data into "lanes" may also be implemented by a single frequency system with serialised data, collision prevention, acknowledgments and handshaking technology, or some other multiplexing system or via a cyclic polling protocol.

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- In a preferred embodiment of the invention, the remote data units generate the ID and time-stamping information. This data may also be generated by the control unit.
- The control unit may be powered with rechargeable batteries to assist in mobility. However, it is to be understood that other energy sources such as traditional power supplies and solar power may be utilised.
- The control unit may include a liquid crystal or other type of display for displaying information, such as results, or for programming purposes, such as by displaying menus or the like to enable selection of protocols or the like.
- The control unit may also include an operating system such as Linux.
- The control unit may be mobile or portable. For example, the unit may be worn by the coach/trainer as they move around the field.
- The control unit may include storage for protocols, data capture or reactive information or additional processing.
- The control unit may store data in a relational database. For example, the control unit may store athlete data and training/competition protocols, past performance and training results and/or capture in progress data and reactive functions and like to enable valuable performance calculations to assist the athlete and/or coach in assessing their performance.
- The control unit may provide storage of data and exchange of data and protocols with the off field network via a hardwired or wireless communication link.

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It is to be understood that the control unit may be connected to one or more additional computerised devices to impart additional functions to the control unit, such as providing additional storage, to assist in exchange of data, power or processing abilities of the control, or to provide an additional programmable fields to the control unit. It should be understood that the control unit may be connected to these one or more additional computerised devices through a hardwired (such as RS232, USB or the like) or wireless (such as GRPS, Bluetooth, 802.11, IR or the like) communication link.

The sports training and testing system of the invention may include one or more additional components as described below.

- One or more remote touch pads that consist of a contact pressure switch connected to a remote data unit. The touch pad can be used as follows:
  - To measure reaction time during starts to identify the first movement of the athlete in response to a stimulus;
  - To act as a trigger switch during certain protocols. For example, a training drill for basketball may require the athlete to run/shuffle to a series of remote data units arranged in a circle around the athlete. The athlete must run to the particular data unit, then return to the touch pad before the next data unit is activated. The athlete must complete 10 of these shuttles as quickly as possible.
  - To measure flight time in jumping activities (this function is known in the industry as a "jump mat")
- Remote starting gun for replicating track sprint starts. The gun can be used as follows:

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- In the present embodiment, the control unit or connected computation device is equipped with a microphone that is used to detect the sound of a traditional starting gun.
- In an alternative embodiment, a substitute gun is used that contains a transmitter for relaying start event to the control unit or remote data units.
- The gun could be replaced by an alternative starting device if desired (e.g. a horn).

- ID Tag System
  - Passive or active ID tags may be worn by the athletes for identity purposes.
  - In this embodiment, when the data capture unit transmits timing and other information (e.g. heart rate), the message includes the ID of the athlete(s) in close proximity to the remote data unit or the control unit.

Whilst off field technology it is not an essential necessary component of the sports training and testing system of the invention, it is may be used as part of the system in the preferred embodiment. In the simplest form of the preferred embodiment of the invention, the off field network may consist of a computer remote from the on field environment. The off field network may include a bi-directional communication link the on field network.

A simple embodiment the communication link between the on field and off field networks would be an off-line solution where the communication between both networks occurs before and after on field sessions. In this case the control unit or the associated computerised devices are brought back to the off field network and connected to the off field terminal. In one embodiment such a connection would be

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via a serial cable connecting the two units. Another embodiment would be via a connection to the parallel port or USB port of the off field terminal. If the control unit is a PDA then the connection to the off field terminal may be via the usual cradle connection between PDAs and typical computers, or via one of the wireless communication options available to these devices.

The off field network may include one or more of the following components:

1.) a workstation and associated software;

2.) a server, preferably a web server; or

3.) a central database storing previously designed protocols and/or downloaded capture data and/or reactive functions.

The off field software may include a number of modules as described as follows:

PROTOCOL Editor

The editor may provide an easy to use software interface for designing new training and coaching protocols and also to enable the editing and modification of existing protocols. Previously designed protocols may be stored in the central database. By having all protocols being able to be designed in this manner, all existing protocols and a host of new protocols can be all created, edited, implemented, managed and run on the apparatus of the invention.

Configuration Downloader

The configuration downloader software module provides a system of downloading the required protocol details to the control unit. The information is provided in such a form that the implementation and on field management of the training protocol is automated from the control unit.

Database Synchroniser

The database stored in the on field control unit or associated computerised device is synchronised with relevant portions of the data in the central database of the off field netwok. After running protocol sessions, the on field data collected at the control unit may be uploaded to the off field network to synchronize to the central database.

Results Analyser

The results analyser software module provides a user interface to a large range of options for displaying, graphing and analysing results from previous sessions stored in the central database. The results analyser also enables the printing of various charts of athlete performance. The control unit may have a wireless Internet link to the off field network via communications link. In this case the communication link between the control unit and the off field network may be made in real time, or directly before and after a protocol session without the need to physically download information to the off field network.

In one embodiment, the control unit may use Internet TCP/IP protocol to connect to a web server and consequently through the web server to the central database of the off field network. This embodiment could use standard software techniques such as Microsoft web, SQL server synchronisation technologies, custom techniques using XML and SOAP, third party database servers like Oracle, Sybase, or Interbase or the like.

In one embodiment, the web server and central database would be running on the same off field network terminal. In other embodiments the web server would be a dedicated web server and the central database is another dedicated server.

There are a number of applications for the sports training and testing system of the invention as described in the following examples.

Example 1

Reactive Sprinting and Agility Training

The remote data unit may measure performance in locomotive movement tasks, and in another embodiment may also collect and relay heart rate, biosensor or other information to the control unit. The reactive units work in conjunction with the data capture units to provide stimuli and direct athletes to perform certain movements. The data capture units in turn monitor the performance in these activities, and provide real-time feedback, or further movement commands, based on these results. The reactive and data capture units may be collectively grouped into a central remote data unit, or may be separated in some situations may be individual units to provide stimulus remote from where feedback information is received.

An example of a protocol that may be utilised in the system is illustrated in FIG. 3 that provides a scenario for a single athlete performing a reactive speed and agility training protocol. The athlete is required to sprint as quickly as possible through the designated gates to complete the drill. The athlete is required to react in one instance to a signal generated outside their field of view, thus relying on peripheral vision and auditory perception to perform the movement change quickly. This particular protocols sets to stimulate four random direction changes. The dotted line in FIG. 3 shows the path that should be followed by the athlete.

In a situation where the athlete is performing several repetitions of such a drill, a starting gate in the system may provide pacing information for the athlete to

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return to the beginning in time for the next repetition. FIG. 4 illustrates the combined use of the reaction time touch pad and multiple gates which may be useful for training or testing for a basketball reactive agility protocol. In this application, the player must stand on the touch pad to begin the drill. After a random time period, a randomly selected random data unit signals the athlete with visual and/or auditory cues. The athlete must move as quickly as possible to the relevant unit, and return to the centre touch pad. The time lag between signalling and the athlete leaving the touch pad is used to assess reaction time. The time taken to a) reach the gate, b) return to the touch pad, and c) the combined time for both movements, are recorded by the system. Once the athlete returns to the touch pad, the sequence is repeated for n number of trials.

FIG. 5 illustrates how the system of the invention may be used to perform simultaneous offensive and defensive reactive speed and agility protocols. In this example, the offensive player is instructed to react to the light stimuli of the remote data units to signify or represent an attacking path despite no ball being in play. The defensive players cannot see the light indicated to the offensive player and must react to the offensive player's movements despite. The dotted line denotes the offensive player's path. In this example, neither offensive nor defensive players have prior knowledge of the direction of movement that will be required. This form of training is not possible when using manual methods, as either the offensive or defensive player rather than a device produces the stimulus for the opposition.

Example 2

Group Reactive Training – Tactical Coaching Applications

A common practice in sports involving tactical patterns of play is to devise, learn and reproduce a range of tactical combinations, or "moves" for use in the competitive environment. In the prior art this aspect of coaching revolves around manual methods. Players will learn a variety of tactical moves devised by themselves and the coach, and the player then chooses whether to "run" these moves at various times in the competitive situation.

The training and testing system of the present invention adds a new dimension to this aspect of sports training. At present, moves are rehearsed at training in a predictable manner. That is, the coach will tell players which move to rehearse, and the players will complete the sequence of actions. With the present invention, the coach can now add a "reactive element" to the rehearsal of team tactical manoeuvres. Rather than running moves one at a time, the coach can devise a tactical "matrix" whereby the players must select from a group of moves as the play unfolds. That is, they must choose a move in "real-time" that best suits the activities of the opposition.

An example of this concept is shown in FIG. 6. In this scenario, the coach has indicated to players that they must choose a combination of actions that gets the ball to the desired point, while each player must also fulfill certain tactical obligations. Referring to FIG. 6, players have to react to the visual cues ad-libbed from various remote data unit and to channel the ball as quickly as possible through the "clear" passages. The players chose the offensive "move" most effective for this passage of play.

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For example, the person third from the top starts with the ball, and must run as quickly as possible to the first remote data unit. The other players must then align themselves to facilitate the fastest transfer of the ball to the next illuminated remote data unit as quickly as possible as indicated by the arrows, and then a further remote data unit may illuminate and the play goes on. The players may not know which first, last or in between remote data units will be the next target which

This concept is not replicated in the prior art. Rather than simply rehearsing set moves and "enforcing" these tactical sequences in the competitive environment, the coach can train players to be reactive to an artificial "opposition" and other environmental stimuli. This system therefore achieves a far superior simulation of the unpredictable sporting environment.

Example 3

Pacing and Race Feedback

The sports training and testing system of the invention may also be used to collate timing information and to provide immediate feedback to the athlete(s) on the progress of their performance. FIG. 7 illustrates the basic function of the system of the invention for athlete timing and pacing. In this example, the athlete is performing a 400m-sprint protocol, though the distance may be modified depending of what is desired event to be performed by the athlete. In this scenario, a traditional starting gun may be used that is connected to the control unit initiating the timing for the event signaling the start of the event. A reaction time touch pad may detect the first movement of the athlete in response to the gun, thus assessing the athlete's reaction time.

As the athlete runs around the track, timing information is collected at N intervals depending on the number and spacing of the remote data units, being flexible and configure at desired points on the track that provide the best performance information to the athlete or coach. The remote data units then send the timing information back to the control unit for storage in the database.

If the database of the control unit, other linked computerised devices or the off field network contains data on the "personal best" performance of ever recorded by this particular athlete, this information may be retrieved to give the athlete instantaneous feedback as to their performance as they run around the track.

In fact, the required pacing between various remote data units may be calculated may be instructed or calculated to provide feedback to the athlete as they are running around the track so that they can determine whether their pace is ahead or behind of the time they are ultimately trying to run. For example, when the athlete is running a time trial, remote data units spaced around the distance the athlete is running may provide feedback at various stages whether the athlete is ahead or behind a pace that enables then to complete the distance they are running within a desired end performance.

For example, FIG. 6 depicts an athlete at the top of the track who is being instructed by the system of the invention that they are 1.3 seconds behind what would enable the personal best performance.

While in this example the athlete is paced according to their previous best performance, this pacing information may be generated by various scenarios, such as:

1.) automatically "replaying" the previous trial for that athlete (default behaviour),

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2.) basing the pacing on the performance of another athlete – for example, data for the world record performance could be entered or recorded into the database,

3.) basing the pacing on a theoretical or a manually derived performance – for example, the coach or athlete may design a custom race strategy and practice this strategy using the system,

4.) basing the pacing on a percentage or absolute improvement on a previous or other performance either uniformly distributed over the event or applied to selected areas of the event. For example, the coach may want the athlete to run 2% faster over the entire event, or, the coach may want the athlete to run 2% faster only during a particular part of the race.

These functions are a major improvement on previously designed pacing and/or timing systems. The combination of freely configurable remote data stations providing accurate and instantaneous delivery of information to and from the control unit allows for any combination of pacing strategies and relational database functions to be used, in either a training or competitive setting.

Multiple Athlete Concurrent Timing and Pacing

This application of the system of the invention is relevant to both training and race situations, and may be easily interfaced with a broadcasting system to provide race information to coaches and spectators. FIG. 8 demonstrates the use of the system in a cycling application. In this particular scenario, the athletes are competing in a race where they are temporally separated by a length of the course (such as known in cycling as an Individual Pursuit). In this scenario, the interval

and lap times of each cyclist as they pass each remote data unit is calculated. The system in turn may produce a visual and/or audio signal at any one of the remote data units to inform each of the cyclists of their relative position in the race with respect to the other cyclist.

For example and as illustrated in FIG. 8, a green signal reading "ahead 1.43" tells the athlete at the bottom of the track that they are currently leading the race by 1.43 seconds. The other athlete at the top of picture, receives a red signal indicating that they are "behind 1.34" seconds. Furthermore, a third coloured light (not illustrated) may be displayed to each rider to indicate his or her progress in relation to a goal performance (e.g. the world record for that event), or to signal that athletes with other information (e.g. "last lap").

<u>Example 4</u>

Multi-station Variable Pacing

The system of the invention may be utilised to pace multiple athletes in different concurrent tasks. For example, the system can be set up to run a number of various "stations", each requiring a different task to be completed within a certain timeframe. Examples of such protocols of course can be used to test the range of fitness of athletes, but is also useful in workplace fitness tests such as those used by fire fighters, the military or law enforcement. These tests require the person to be tested to perform a range of different tasks within set timeframes.

An example of such a multi-tasking test in a sporting context is shown in FIG. 8. This specific example demonstrates the Rugby Specific Circuit Test (RSCT) which was developed to imitate the physiological demands of 15 minutes of rugby union match play. The test contains a variety of stations requiring different

tasks to be performed. Some of these tasks are to be performed at maximal pace (such as sprints), while for other tasks a goal pace is set for each athlete to complete the station. In the example shown in FIG. 8, players are required to complete three laps of this 8-station functional fitness test. The system of the invention can pace athletes through the various segments of the circuit, and provide real-time measurements and feedback on performance.

With specific reference to this example, the system of the invention can perform several desired functions as follows:

1.) It can record and database timing information for each athlete as they perform the various tasks.

2.) It can signal the athlete when to begin each station after a set rest period.

3.) It can provide pacing information to the athlete throughout the various stations.

4.) It can provide feedback to the athlete as to whether or not they are achieving the desired performance.

In a preferred embodiment the system of the invention may also perform the two following functions:

1.) It can collect and relay data from other measurement objects. For example FIG. 8 depicts a series of stations. Station 4 in this scenario is a sports ergometer (GRUNT 3000), which measures speed and force data during impact activities. In such an application, remote dat unit can perform the additional function of collecting the outputs from the ergometer, and relaying this to the control unit. While this ergometer is only one example, similar information from

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accelerometers, biosensors or accuracy/skill monitoring devices could also be collected.

2.) In the preferred embodiment involving the use of an ID tag attached to each athlete, the system of the invention could conduct multi-station protocols in a fully automated fashion. In this embodiment the ID of each athlete would be detected as they entered into each of the task stations.

Example 5

Automated PROTOCOL Management

The integration within the on field and off field networks of the invention provides at least one method for the complete automation of a wide range of fitness tests. Referring to FIG. 1, an automated protocol management system that may be utilised in the present system of the invention may contain one or more of the following functions:

1.) the designing/editing of protocols off-field for use in the field, and downloading these to the on field control unit;

2.) detailed mentoring of the user through the process of setting up the equipment for executing a protocol in the field;

3) signalling the beginning and end of a protocol, and all required intermediate signals for the athlete and coach;

4.) collecting data and storing it in the on field or off field database;

5.) uploading data from the on field control unit to the off field network, such as database and analysis software to provide either online or offline information to the athlete or the coach;

6.) producing basic reports from the data in the on field control unit and/or more detailed analysis and reports from the off field database and software;

7.) Sharing of data between the on field and off field networks, and other networks (e.g. web based data sharing).

Other modifications to the invention may include:

1.) Replacing the current measurement device (photo beams) with TAG tracking, GPS, Ultrawideband impulse radio tracking, radar (sonar tracking) or "beams" created using laser or Microwave technology.

2. Modifying the method for on-field networking suing another wireless protocol such as Bluetooth, 802.11 or WiFi.

3.) Substituting the components for providing visual and auditory cues to the athlete. These may include using alternative light sources, video displays, LCD displays, holographic projections or virtual reality displays.

The methods, apparatus and systems of the invention have broad uses in a wide range of sports for use in training, testing, and competitive environments. The system not only has applications for using by the sporting community, but also for workplace and other function performance situations that require methodical monitoring and feedback on speed and ability of movement.

It will of course be realised that while the foregoing has been given by way of illustrative example of this invention, all such and other modifications and

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variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein set forth.

DATED THIS FOURTEENTH DAY OFJULY, 2003

FUSION SPORT PTY LTD

BY

PIZZEYS PATENT AND TRADE MARK ATTORNEYS

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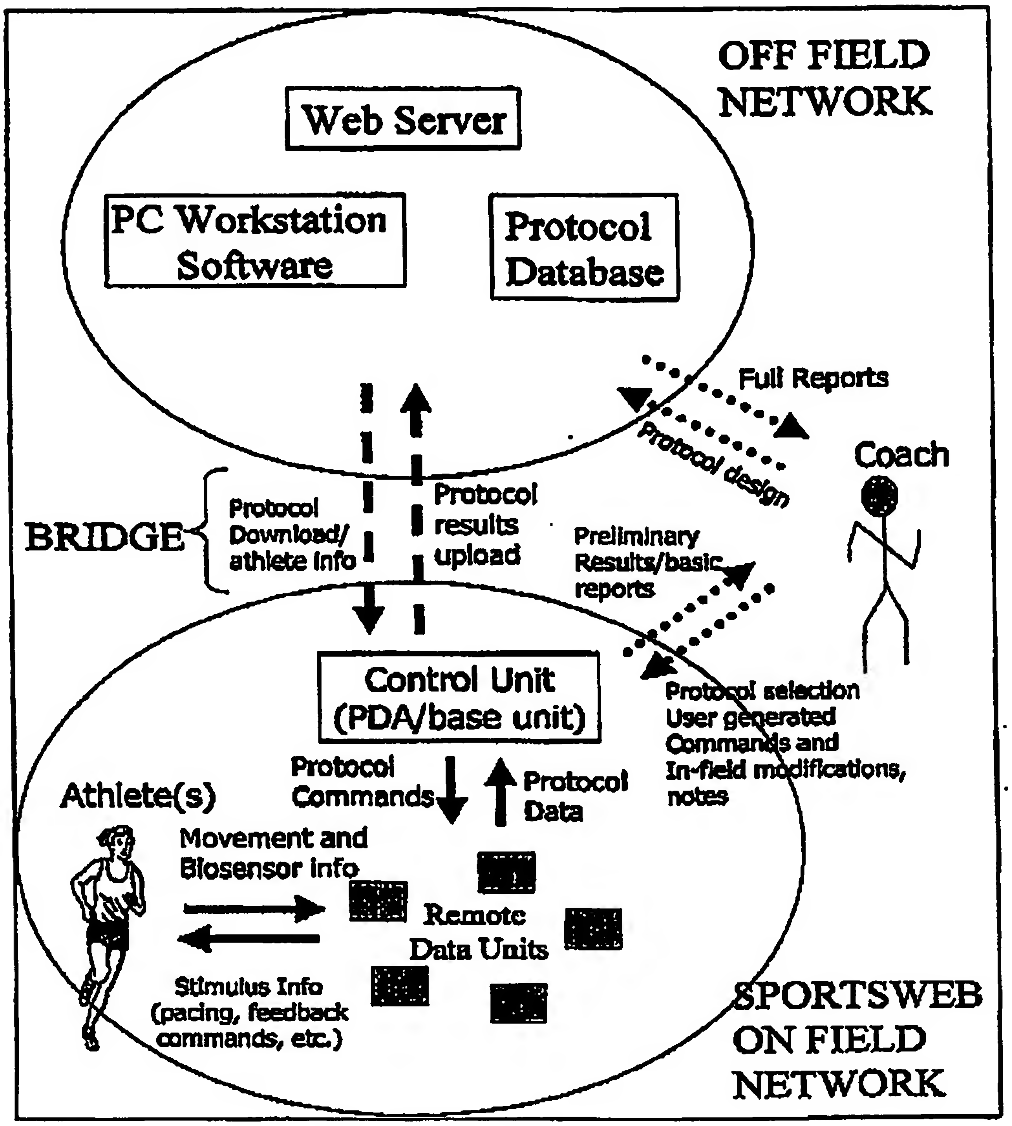

FIG. 1

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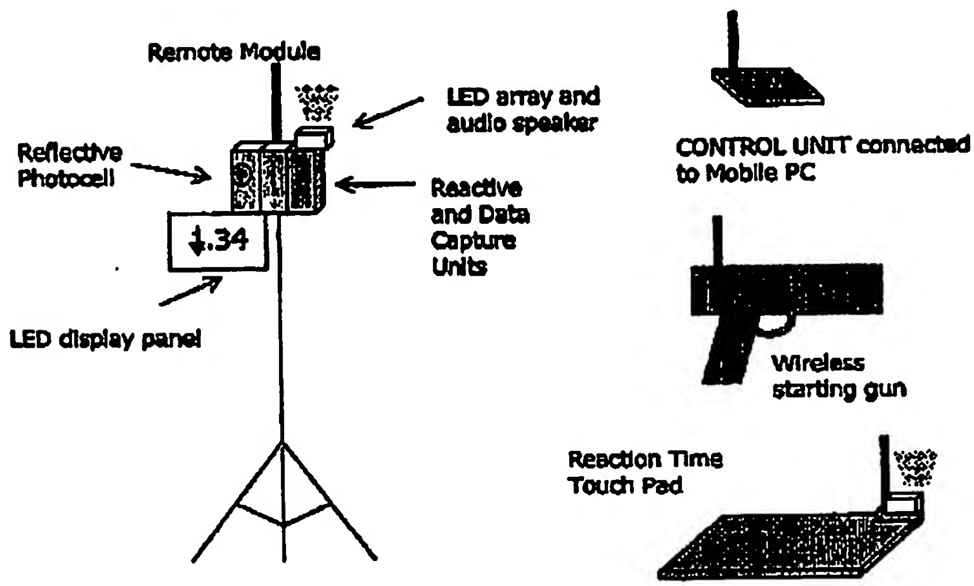

FIG. 2

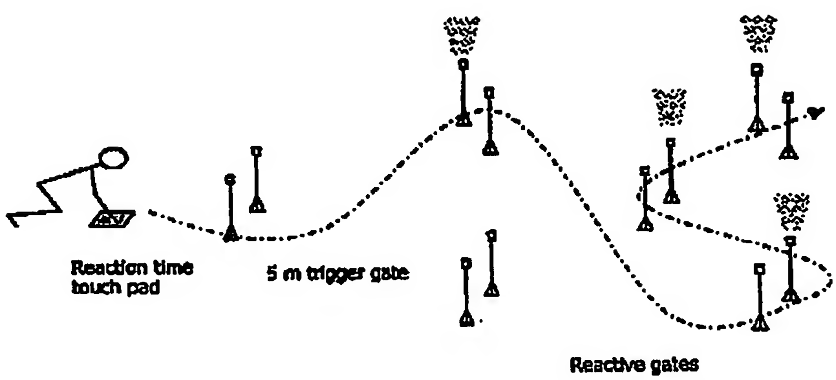

FIG. 3

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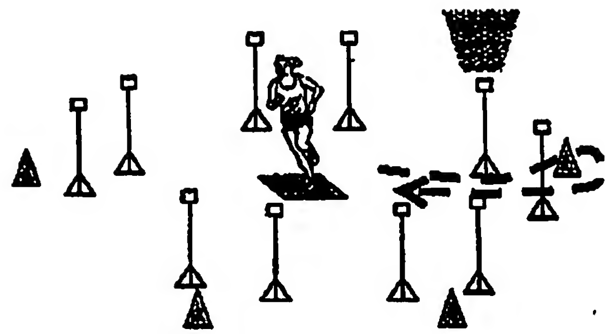

FIG. 4

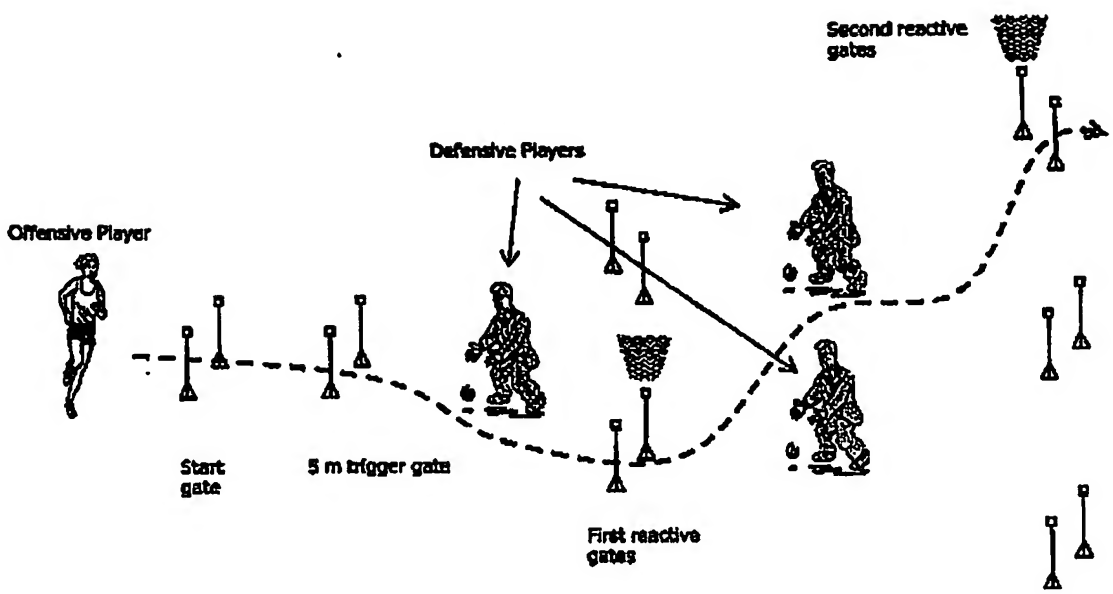

FIG. 5

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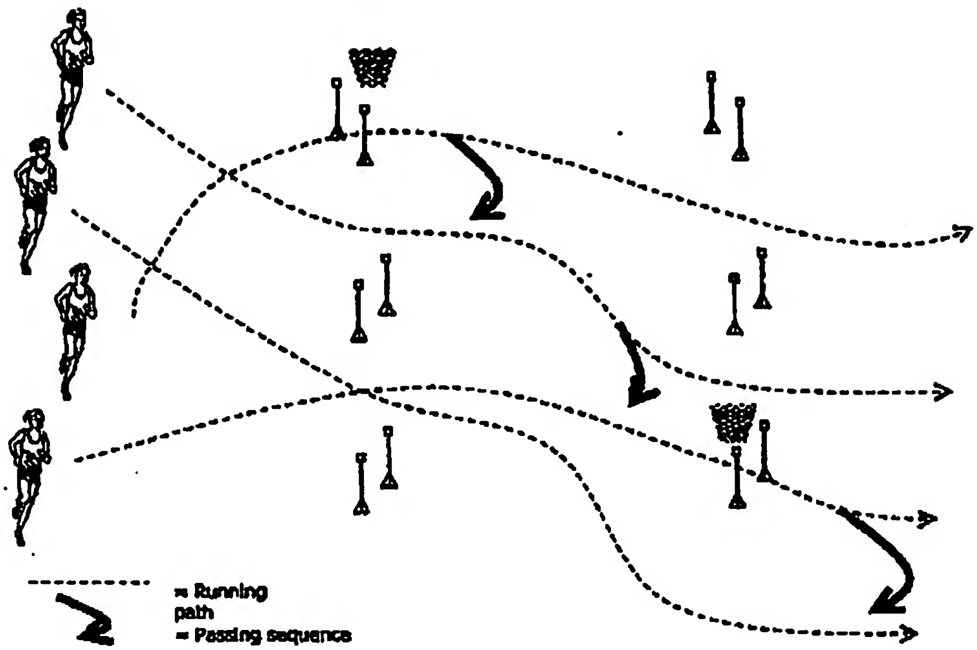

= Running path
= Passing sequence

FIG. 6

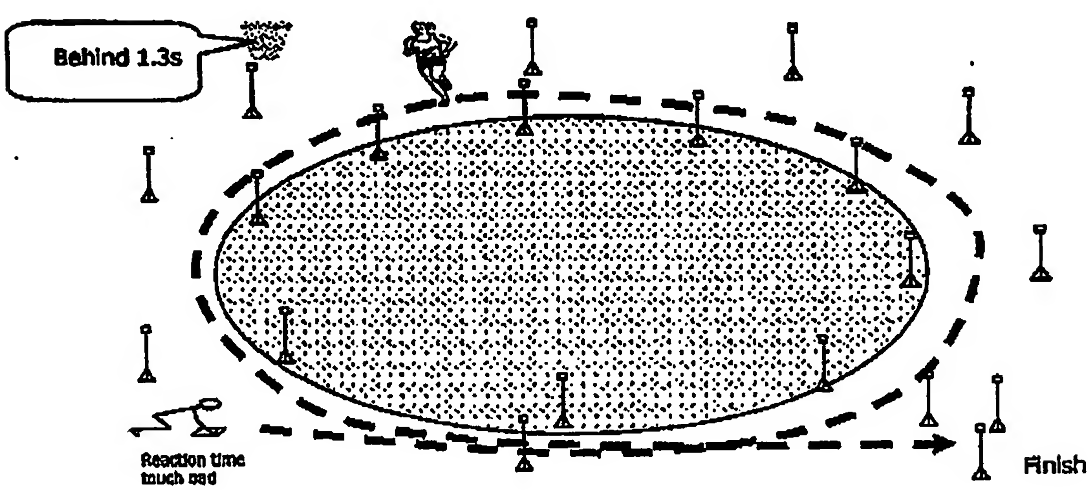

Behind 1.3s
Reaction time touch pad
Finish

FIG. 7

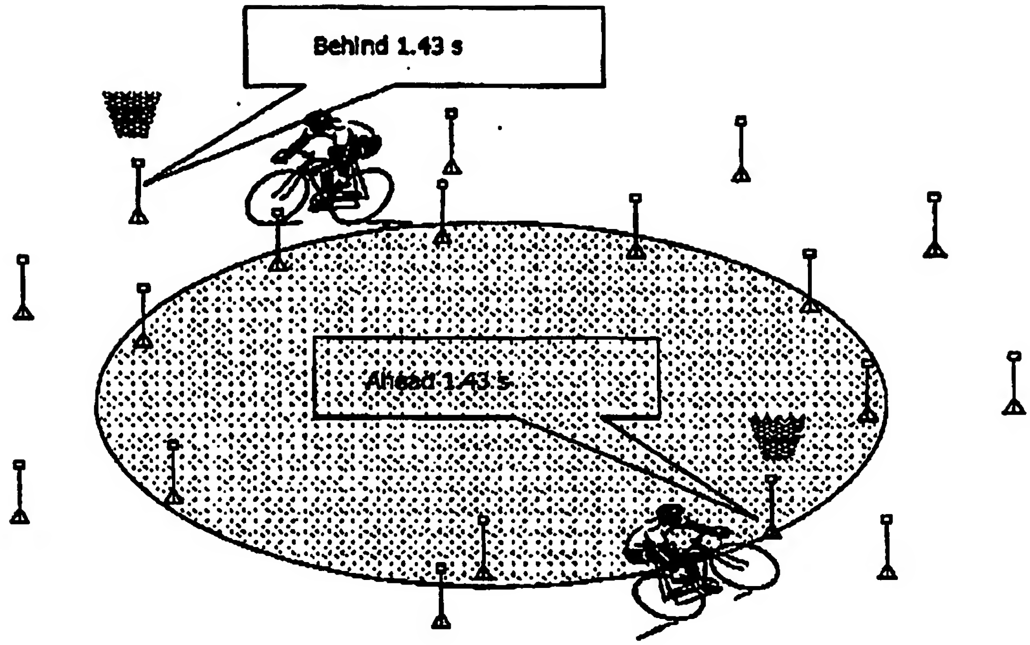
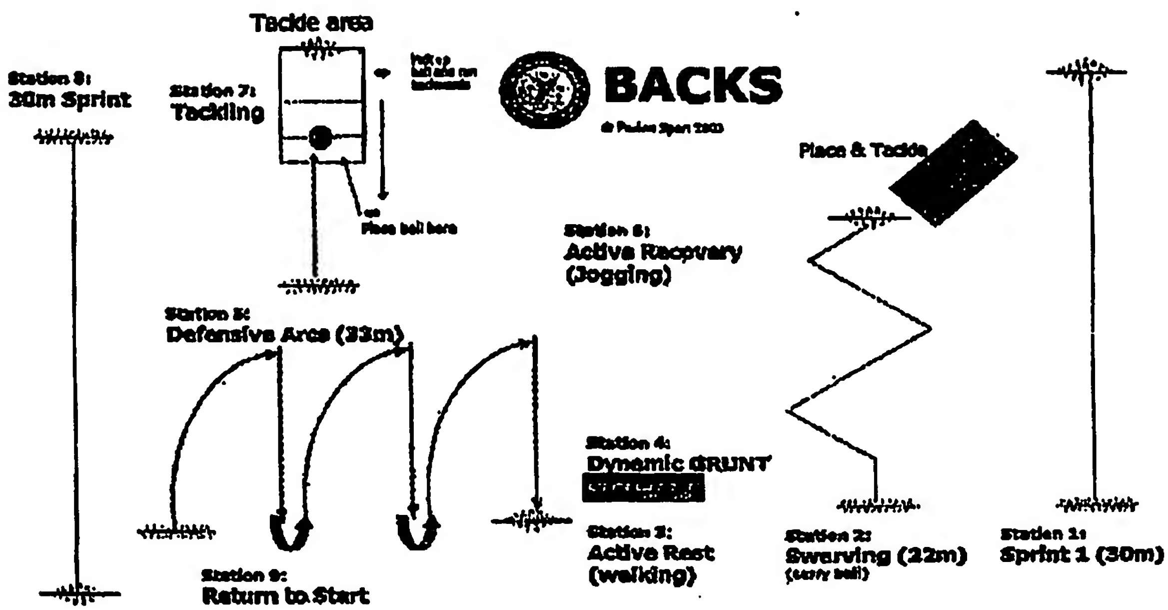


FIG. 8



Tackle area
Station 8:
30m Sprint
Station 7:
Tackling
Place ball here
BACKS
Place & Tackle
Station 6:
Active Recovery
(Jogging)
Station 5:
Defensive Area (33m)
Station 4:
Dynamic GRUNT
Station 3:
Active Rest
(walking)
Station 2:
Swerving (22m)
(carry ball)
Station 1:
Sprint 1 (30m)
Station 9:
Return to Start

FIG. 9